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ORIGINAL PAPER

Local perceptions of the conversion of cropland to forestland program in Jiangxi, Shaanxi, and Sichuan, China

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Abstract Numerous land-use policies have been implemented in China in recent decades for ecological restoration and conservation to reduce environmental disasters and promote environmental sustainability. Many of these policies follow a top-down approach to implementation and as such, emphasize the hierarchical control within government structures. An understanding of local perceptions of land-use policies is important if the disconnect between policy makers and the target population is to be reduced and if program support is to improve. This study aimed to help improve local implementation, attitude toward, and engagement by examining the influence of socio-economic characteristics on the target population's (local farmers) perception of the conversion of cropland to forestland program (CFPP) land use policy in Jiangxi, Sichuan, and Shaanxi provinces. It uses logistical regression models, with robust aspects of perception including confidence, support, transparency, prospects, fairness, and willingness to participate. Results indicate that social aspects as well as economic aspects are most important in influencing farmers' perceptions towards the CFPP. The farmers who have received technical support, rural male habitants, educated, and non-middle-aged farmers exhibit more positive perceptions of the program and are much more likely to support it, whereas farmers without any technical support or formal education, and female and middle-aged farmers are less likely to support the program. Importantly, this study also reveals the differences in responses, experiences and perceptions of the farmers living across different provinces. These empirical results provide insight into the influence of socio-economic characteristics on the perception of farmers towards land-use

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policies, which has important implications for designing targeted policy instruments and increasing farmer support for these policies. This knowledge can be harnessed and further evaluated in future research to improve citizen engagement, support, and understanding in order to help ecological restoration and conservation objectives be more effectively achieved.

Keywords Forest policy · Ecological restoration · Local perception · Social sustainability · Land-use and change · China

Introduction

Public perception is a critical component of the socio-economic context in which policy makers operate (Leiserowitz 2006). In top-down approaches to policy implementation, which emphasize hierarchical control within government structures (Koontz and Newig 2014), understanding local perceptions of land-use policy is critical to lessening the inherent disconnect between policy makers and the target population(s), as policy makers are often far removed from the target population (DeLeon and DeLeon 2002). Understanding local perceptions and its socio-economic determinants are crucial for the success of the policy and program, as local populations are the main participants as well as the most affected (Xu et al. 2010). Failing to understand farmers' socio-economic determinants and perceptions may result in poorly implemented and ineffective land-use policies (Choi 2004). With the goal of improving local implementation, perception, and engagement, this study sought to examine the responses, perceptions and socio-economic determinants of a target population (local farmers) to land-use policies in China. This study examined a major land-use policy, the Conversion of Cropland to Forestry Program (CCFP) (Wang 2009; Delang and Yuan 2015; Hua et al. 2016; Rodríguez et al. 2016), along with the responses of the local populations to this policy.

The CCFP has been referred to as one of the largest and most significant reforestation programs in China and in the world (Delang and Yuan 2015; Hua et al. 2016), and is therefore of interest due to its large scale, coverage and funding. The program's main goal is the reforestation of farmland (Figs. 1, 2) (Delang and Yuan 2015), and serves as a useful point of analysis for investigating the response of a local population to a major land-use policy. This manuscript is the first in a series of studies on land-use change in China, providing background on key policies and a preliminary analysis of the perceptions of affected farmers.

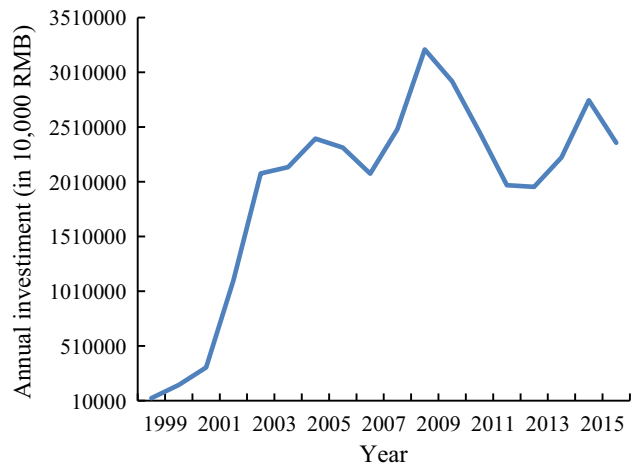

Fig. 1 Annual total investment in the CCFP from 1999 to 2016 in China (Source: SFA 2017) (* Please note that throughout this paper, US$1 = 6.91RMB (2016))

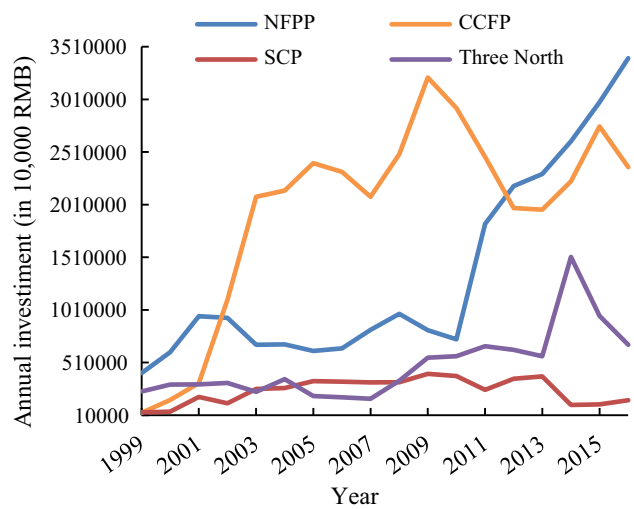

Fig. 2 Comparison between annual total investment in the CCFP and other SKFPs (Natural Forest Protection Program (NFPP), Sand Control Program for Areas in the vicinity of Beijing and Tianjin (SCP), Three North Shelterbelt Development Program and the Shelterbelt Development Program (Three North) (Source: SFA 2017). Present study dataset specifically refers to CCFP

Conversion of cropland to forestland program

The conversion of cropland to forestland program (CCFP), also known as the Grain-to-Green Program or Sloping Land Conversion Program, was implemented in 1999 to convert farmland and desertified areas back into grasslands and forests in order to increase forest cover and prevent land degradation, flooding and erosion in high-risk areas (Wang et al. 2008). The program announced that it would attempt to convert 14.7 million ha of farmland, 4.4 million ha of land located on slopes > 25° (Bennett 2008) and 17.3 million ha of barren hills, mountains, and sand to forest or

grasslands by the end of 2010 (Wang et al. 2007; Zhai et al. 2014). The CCFP has been referred to as the largest rural reforestation program in the world (Hua et al. 2016) and, as shown in Fig. 2, the total investment in the CCFP was noticeably larger than other key forestry programs in China (See Wang et al. 2008 for details about Six Key Forestry Programs, SKFPs). The program impacted 1900 counties across 25 provinces, engaging nearly 32 million farm families or 124 million people, 17% of the rural population (Yao et al. 2010; SFA 2014). Additionally, the CCFP incorporated a large-scale Public Payment for Ecosystem Services (PPES) scheme, with local farmers in economically disadvantaged populations in hilly, mountainous and upstream areas being compensated with financial subsidies by local and central governments (Milder et al. 2010; Yin and Yin 2010).

The CCFP, and especially its subsidy scheme, has received criticism. Local farmers were not consulted during its design and implementation and as a result, their expertise regarding the local landscapes was not taken into account (Yin et al. 2005). Additionally, corruption in local governments meant that subsidy payments did not always make it to the farmers, leading to numerous lawsuits (Yin et al. 2005; Delang and Wang 2013). There have also been criticisms of the amount of money spent on the CCFP and arguments that more land could have been converted through an alternative scheme using the same amount of money (Delang and Yuan 2015). Fig.s 1 and 2 show the size of the investment in the CCFP and how it compares to other similar forestry land-use policies.

At an international level, the CCFP is comparable in scale to the Forest Conservation Act of India and the different iterations of the 10-year Forest Development Plans of South Korea. The Forest Conservation Act of India aimed to prevent forestland from being converted to non-forest uses, and used compensatory afforestation tactics similar to the financial subsidies of the CCFP (Ravindranath et al. 2008). In South Korea, the first 10-year Forest Development Plan was implemented in 1973 in response to significant deforestation during the Korean War and aimed to convert and reforest one million hectares of land (UNCCD 2006). These plans have been noted in recent accounts as remarkably successful with over two million hectares of land reforested (Park and Youn 2017). The success of Korea's programs has been largely attributed to good government policies on monitoring and protection, economic development, and an active involvement of citizen population in the forestation programs (Kim et al. 2017).

Importance of local perceptions

The CCFP uses policies that enforce a top-down approach to implementation, as the program was introduced and implemented by the Central Government (Liang et al. 2012). To ensure that policies like these are effective and sensitive to local conditions, it is important to understand the perceptions and responses of local farmers (the target population), as the success of any such policy is often dependent upon local support. As such, a more integrated approach to this type of decision-making that takes into consideration the expertise of local farmers has been recommended (Vaidya and Mayer 2014). Local support is strongly influenced by the perception of the impacts experienced by local communities and, although there is a growing body of knowledge regarding the impacts of similar land-use change programs on forest areas (Wang et al. 2008; Wang 2009) and rural livelihoods (Uchida et al. 2005; Liang et al. 2012) in China, local responses are often complex and include multiple factors beyond income or sustainability. Many previous studies have concentrated on only one or two main impacts, when in practice there may be many. For example, Peng et al. (2007) used questionnaires to study perceptions of the level of accomplishment of CCFP participation, using this as a proxy for local farmers' response to the program. Zhang et al. (2008) primarily considered sustainability of the CCFP through an integrated assessment approach, but the only consideration of respondents' perceptions was based on their reported likelihood to reconvert their land back to its original state. Wang and Maclaren (2012) analyzed local perceptions of land-use change by observing respondents' levels of participation.

Recent studies in the counties of Shaanxi, Sichuan, and Jilin show that local farmers affected by land-use change policies generally support the projects and have a positive response or attitude towards the compensation received from the CFPP. However, local people are concerned about their future livelihoods once the subsidies end (Yanqiong et al. 2003; Cao et al. 2009; Wang and Maclaren 2012). This finding has been corroborated by case studies in Ningxia and Zhangye in Gansu province (Peng et al. 2007; Zhang et al. 2008).

Most studies on this topic, however, have been limited in scope, as they are often conducted as small-scale case studies in a single geographical region (Yanqiong et al. 2003: one province; Peng et al. 2007: one prefecture; Zhang et al. 2008: one autonomous region; Cao et al. 2009: one province; Wang and Maclaren 2012: one county; Feng and Xu 2015: one province). The lack of geographical scope may be intentional due to the logistical difficulties involved in communicating with the population of interest.

Land-use change policies primarily affect rural areas in poor counties, and it is difficult to contact these subjects on a large scale as many locals do not have access to telephones or electronic means of communication, or they live in especially remote areas far from roads (Zhang et al. 2008). Some studies have analyzed farmers' perceptions in multiple Chinese provinces, such as Sjögersten et al. (2013) and Song et al. (2014). However, the former did not include the CCFP and the latter used a small sample size of 146 respondents (in comparison to the 1089 respondents of this study). Additionally, when farmers' perceptions have been examined, most studies have only used a single dependent variable, such as whether they support the project (Cao et al. 2009) or are willing to participate (Feng and Xu 2015).

In contrast, this study investigates local farmers' perceptions and responses to land-use change policies by analyzing multiple aspects of perception including confidence, willingness to participate, prospects, and perceived transparency and fairness of the programs, and covers three provinces. Jiangxi, Shaanxi, and Sichuan were selected to represent a diverse cross-section of the geographical variability affected by the CCFP and flooding of the Yangtze and Yellow River basins (Rodríguez et al. 2016).

Materials and methods

Research questionnaire and variable selection

A structured questionnaire was developed to collect data on various socio-economic and related variables that are likely to influence the perceptions, responses and/or attitudes of farmers towards land-use policies. Questionnaires were delivered via a joint effort between local forestry agencies and various state government agencies, and were tailored to investigate the characteristics and responses of local farmers from five different aspects:

(1) Understanding of the CCFP;
(2) Participation in the CCFP;
(3) Outlook on the effectiveness of the CCFP;
(4) Opinions and suggestions for the CCFP;
(5) Characteristics of the sample households.

Variables used in the analysis were predominately selected from the characteristics of aspects (2), (3), and (4). The questionnaire was distributed in Chinese and as a result there are some nuances regarding translation. The Chinese term for 'project' was used interchangeably with 'CCFP' on the questionnaires, even though the CCFP is referred to as a "program." In Chinese, programs and projects can often be referred to using the same term colloquially, whereas in English, they have different connotations. For the sake of consistency and clarity, this manuscript will similarly use the terms project and CCFP synonymously.

Sampling procedure

In order to yield appropriate respondents for the study, samples were selected at both the provincial and county level. Target respondents for the questionnaire were local farmers affected by the CCFP.

Selection of provinces

One purpose of the CCFP is to reduce areas of heavy flooding using forest restoration (Wang et al. 2008) and a suite of programs were implemented to combat flooding from the Yangtze and Yellow Rivers in the late 1990s (Wang et al. 2008). It is therefore appropriate to examine areas of high flooding, as these were the areas initially targeted by the CCFP. Using this criterion, three provinces (Jiangxi, Shaanxi, and Sichuan) were selected to represent the variation between areas heavily affected by the CCFP. Shaanxi is located in the Yellow River Basin and the Loess Plateau region where soil erosion has been a greater issue relative to other areas in the Yellow River Basin (Fang and Xie 1994; Zhou et al. 2009), and Sichuan and Jiangxi were selected to represent upstream and downstream areas of the Yangtze River, respectively. In Sichuan, the upstream area contains a large depression known as the Sichuan Basin which is particularly notorious for extensive flooding as a result of human activities (Zong and Chen 2000). This area was heavily deforested in the late 20th century due to a reliance on timber supplies within the province, as well as widespread clear-cutting aimed at providing land for grain production (Zong and Chen 2000; Smil 2004). In Jiangxi, the downstream area of the Yangtze River flows into Poyang Lake, the largest freshwater lake in China, which often experiences heavy flooding (Zong and Chen 2000). In 1998 in particular, heavy rainfall raised the lower reaches of the Yangzte River in Jiangxi past historic levels (Zong and Chen 2000). The coverage of the CCFP, as well as these three provinces of interest, is shown in Fig. 3.

The selected survey provinces are representative of a gradient of ecological and climatic conditions present across the areas targeted by the CCFP. Shaanxi is representative of northwestern China with a dry, arid environment and fertile, calcium-rich soils and rolling topography common in the Loess Plateau and northwestern regions (Shi et al. 2016). In southeastern provinces such as Jiangxi, abundant rainfall and a warm, humid climate is typical due to the influence of the sub-tropical Pacific Ocean (Dongmei et al. 2007). Lastly, Sichuan was selected due to its rugged and mountainous topography and its mild to sub-tropical

Fig. 3 Provincial map of CCFP coverage and the three provinces of interest

climate typical of southwestern China (He and Tang 2008). As such, these three provinces cover the range of geographical areas targeted by the CCFP.

From a socio-economic perspective, Sichuan has the highest rural income (includes income from agriculture, forestry, animal husbandry, and fishery) of the three provinces, with an average annual income of 52,813 RMB ($ 7642.98 USD @ 6.910 RMB). Jiangxi and Shaanxi have lower average rural annual incomes of 35,473 RMB ($ 5133.58 USD) and 48,185 RMB ($6973.23 USD), respectively (NBS 2016). Sichuan has the largest rural population with nearly 70 million people, followed by Jiangxi with a rural population of 36 million, and Shaanxi with about 27 million (NBS 2015).

Selection of counties

Rural counties were strategically selected within each of the three provinces based on economic development criteria. The aim was to ensure that the socio-economic status of respondents was representative across an economic gradient, as this may potentially influence local perceptions of national land-use change policies. Using GDP tertiles, counties were divided into three groups of economic development levels (low, medium, and high). The number of counties selected from each province was a function of the population size of each county, in addition to their GDP tertile, to ensure that each province included a proportional representation of counties with each level of economic development. A total of 32 counties were selected, including: 10 in Shaanxi (Wuqi, Ansai, Chunhua, Hengshan, Lantian, Zhen'an, Jingbian, Mianxian, Yijun, and Shiquan); 10 in Jiangxi (Shanggao, Yujiang, Fenyi, Nancheng, Yiyang, Pengze, Taihe, Fuliang, Shicheng, and Luxi); and, 12 in Sichuan (Nanjiang, Nanbu, Xuyong, Tianquan, Ningnan, Anyue, Fushun, Chaotian District, Hongya, Luding, Muchuan, and Changning). Note that while Ansai is technically a district, its geographic size and population is on par with many of Shanxi's other rural counties, and therefore, it was included as a county by the agencies carrying out the questionnaire.

Selection of sample households

Quota and convenience sampling were used to select 50–60 farmers in each county. Questionnaires were distributed by post. Farmers were selected using a random number generator, where every farmer in the county was assigned a number. The number of farmers selected in each county varied depending on the county's geographic size and population (i.e., larger counties were represented by more farmers). A total of 1800 households received the questionnaire. Responses were completely voluntary and no compensation was offered to the respondents. A response rate of 60% was obtained, with 1089 completed questionnaires returned.

Summary statistics for the main socio-economic characteristics of the respondents are provided in Table 1. More detailed information on socio-economic characteristics are provided in the electronic supplementary material (Appendix S1-6).

Statistical analysis

Using SPSS version 17.0, six individual logistic regression (LR) models with odds ratio (OR) estimation were used to analyze the socio-economic factors that influence perception and attitudes of local farmers regarding various aspects of land-use policies in the area. All results are reported in the following section. The choice to use a logistic model was due to its widespread usage in empirical modelling of qualitative choice dependent variables (McFadden 1984), which fit well with the dependent variables used in this study.

Dependent variables

The following dependent variables were tested in relation to the CCFP: (1) confidence, (2) willingness, (3) prospects, (4) transparency, (5) support, and (6) fairness. These dependent variables represent various aspects of how respondents perceive the CCFP.

These six dependent variables were derived from the following six survey questions (translated from simplified Chinese):

1. How confident are you in the completion of the CCFP?
2. How willing are you to participate in the CCFP?
3. What do you think of the prospects of the CCFP?
4. How transparent do you think the CCFP is?

Table 1 Summary statistics of respondent characteristics

Gender		
Gender	Frequency	Percentage (%)
Male	669	66%
Female	343	34%
Age		
(Years)	Frequency	Percentage (%)
< 24–34	122	12
35–54	646	64
55–> 65	244	24
Income		
RMB	Frequency	Percentage (%)
< 15,000 RMB	348	34
15,000–19,999 RMB	174	17
20,000–24,999 RMB	96	10
25,000–30,000 RMB	137	14
> 30,000 RMB	257	25
Education		
Degree	Frequency	Percentage (%)
No Education	96	10
School	875	86
University/College Undergraduate	41	4
Additional income data (RMB)		
	Mean	Standard deviation
Income before CCFP	11,492.79	12,815.85
Income after CCFP	26,244.25	28,626.60
Income difference after CCFP	14,751.46	23,752.56
Migratory work		
	Mean	Standard deviation
Number of migrant workers in household	1.16 Worker(s)	0.99 Worker(s)
Number of days of migrant work	176.65 Days	126.33 Days

5. What is your level of support for the CCFP?
6. How fair do you think implementation of the CCFP is?

These variables were selected based on previous studies of the rural population's perception and attitude towards the CCFP conducted by the State Forestry Administration and several Chinese universities (SFA 2003–2015; Zhu 2014).

Independent variables

Independent variables include province, age, gender, education, level of technical support received from the government, and changes in income from before and post-implementation (Table 2). Interaction effects between some of these independent variables were also explored.

All of the OR are reported in the Exp (B) columns in Tables 3, 4, 5, 6, 7 and 8 as they are easier to interpret than the coefficient for a logistic regression and represent relative odds of the occurrence of a given outcome (Szumilas 2010). The interpretation of odds ratios are as follows: OR = 1 means that the variable of interest does not affect the odds of the outcome, OR > 1 means that the variable of interest is associated with higher odds of the outcome, and OR < 1 means that the variable of interest is associated with lower odds of the outcome.

Results

Confidence in completion of the CCFP

A logistic regression (LR) model was run to test the effect of the predictor variables on the likelihood that local farmers had confidence in the completion of the CCFP. The LR model explained 64% (Nagelkerke R^2) of the variance in famers' confidence that the CCFP will be completed, and correctly classified 91% of cases. Farmers from Jiangxi had lower odds of being confident that the project would be successfully completed compared to farmers from Sichuan and Shaanxi (OR: 0.184; $p = 0.005$) (Table 3). Male respondents had higher odds of confidence in project completion than female respondents (OR: 7.924; $p = 0.000$). Moreover, male respondents in Jiangxi and Shaanxi had higher odds than male respondents in Sichuan of confidence in the completion of the project (OR: 0.117; $p = 0.001$ and OR: 0.89; $p = 0.001$ respectively) (Table 3). Both of the younger age groups of farmers (aged 24–34 and 35–54) had lower odds of confidence in the project completion than the older age group (55+ years old) (OR: 0.394 $p = 0.032$ and OR: 0.474 $p = 0.033$ respectively). There were no significant differences between the three education categories (illiterate, high school, and university educated). Farmers who received higher income from the program were not significantly different in terms of their confidence in the project reaching completion than those who did not have an increase in income. The response of farmers who did not receive technical support was not significantly different from those who did.

Table 2 Independent variables and possible responses included in the questionnaire

Independent variable	Variable type	Possible response
Province	Categorical independent	Jiangxi
		Shaanxi
		Sichuan*
Age	Categorical independent	Group 1: 24–34 years old
		Group 2: 35–54 years old
		Group 3: 55+ years old*
Gender	Binary independent	0: male
		1: female*
Education	Categorical independent	Level 1: no education
		Level 2: elementary/high school education
		Level 3: university education*
Level of technical support	Categorical independent	Level 1: No support
		Level 2: Received some support
		Level 3: Highly supported*
Income difference	Continuous independent	Derived from income difference before and after implementation of the CCFP

*Base variable in the logistic regression analysis

Table 3 Regression output results with confidence as the dependent variable

Independent variables	B	S.E.	Wald	DF	Sig.	Exp (B)
Province			7.835	2	0.02	
Jiangxi	− 1.695	0.608	7.779	1	0.005	0.184
Shaanxi	− 0.373	0.55	0.46	1	0.498	0.689
Gender (1)	2.07	0.573	13.036	1	0	7.924
Age			5.484	2	0.064	
Age (24–34 year)	− 0.931	0.434	4.606	1	0.032	0.394
Age (35–54 year)	− 0.747	0.351	4.528	1	0.033	0.474
Education			15.446	2	0	
Education (No education)	− 2.055	0.749	7.527	1	0.006	0.128
Education (School)	− 0.105	0.571	0.034	1	0.854	0.9
Difference	0	0	5.983	1	0.014	1
Technical support			138.333	2	0	
Technical support (no)	− 4.561	0.558	66.88	1	0	0.01
Technical support (some)	− 0.856	0.614	1.944	1	0.163	0.425
Gender * Province			11.98	2	0.003	
Gender(1) * Jiangxi	− 2.149	0.763	7.934	1	0.005	0.117
Gender(1) * Shaanxi	− 2.415	0.735	10.791	1	0.001	0.089
Difference * Province			15.288	2	0	
Difference * Jiangxi	0	0	9.379	1	0.002	1
Difference * Shaanxi	0	0	14.532	1	0	1
Constant	5.68	0.948	35.899	1	0	293.042

Variable(s) entered on step 1: Province, gender, age, education, difference, technical support, gender * province, difference * province

B is the coefficient for the constant (also called the "intercept") in the null model., S.E. is the standard error around the coefficient for the constant. Wald test is the test of significance for individual regression coefficients in logistic regression. Sig. is the *P* value and a significant value indicates that the present model is an improvement over the previous model. DF is the degrees of freedom for the Wald Chi-square test

Table 4 Regression output results with willingness as the dependent variable

Independent variables	B	S.E.	Wald	DF	Sig.	Exp (B)
Province			5.973	2	0.05	
Jiangxi	0.109	0.486	0.051	1	0.822	1.116
Shaanxi	0.968	0.405	5.712	1	0.017	2.632
Gender (1)	1.173	0.395	8.811	1	0.003	3.233
Age			7.452	2	0.024	
Age (24–34 years)	− 0.437	0.39	1.258	1	0.262	0.646
Age (35–54 years)	− 0.797	0.3	7.071	1	0.008	0.451
Education			13.247	2	0.001	
Education (no)	− 1.722	0.655	6.905	1	0.009	0.179
Education (school)	− 0.245	0.528	0.215	1	0.643	0.783
Difference	0	0	3.802	1	0.051	1
Technical support			135.721	2	0	
Technical support (no)	− 3.273	0.469	48.755	1	0	0.038
Technical support (some)	− 0.363	0.494	0.54	1	0.462	0.696
Gender * Province			10.491	2	0.005	
Gender(1) * Jiangxi	− 1.75	0.618	8.031	1	0.005	0.174
Gender(1) * Shaanxi	− 1.506	0.563	7.164	1	0.007	0.222
Constant	3.017	0.78	14.967	1	0	20.44

B is the coefficient for the constant (also called the "intercept") in the null model

Willingness to participate in the CCFP

The same predictor variables were tested to provide insight into the willingness of farmers to participate in the CCFP. This LR model exhibited a Nagelkerke R^2 of 54%, with just over half of the variation in responses being explained by the model, which correctly classified 85% of the cases. Farmers from Shaanxi had higher odds compared to farmers from Sichuan of being willing to participate (OR: 2.632; $p = 0.017$), whereas Jiangxi farmers did not differ significantly from respondents in Sichuan (Table 4). Male respondents had higher odds of being willing to participate in the program than their female counterparts (OR: 3.233; $p = 0.003$), although male respondents in Jiangxi and Shaanxi had lower odds than those in Sichuan (OR: 0.174; $p = 0.005$ and OR: 0.222; $p = 0.007$ respectively) (Table 4). Respondents between 35 and 54 years old were less likely to willingly participate in the CCFP compared to 55+ year old respondents (OR: 0.451; $p = 0.008$). Respondents between 25 and 34 did not significantly differ from 55+ year old respondents. Farmers that reported no education had lower odds of being willing to participate than farmers with a university-level education (OR: 0.179; $p = 0.009$), whereas there were no significant differences between those with high school education and university-level education. Farmers who experienced an increase in income since the implementation of the program were not significantly different from those who did not experience an increase in income.

Prospects regarding the CCFP

When running predictor variables against farmers' responses regarding the prospects of the CCFP, the LR model exhibited a Nagelkerke R^2 of 68% and correctly classified 92% of cases. No significant difference was found in the perception of farmers from different provinces, with differing education levels, or with age (Table 5). However, male respondents appear to have much higher odds than the female respondents of viewing the CCFP as positive (OR: 80.716, $p = 0.002$), but male farmers in Jiangxi and Shaanxi had lower odds in comparison to male respondents in Sichuan (OR: 0.113; $p = 0.012$ and OR: 0.087; $p = 0.003$ respectively). Respondents who experienced an increase in personal income since the implementation of the program were not significantly different from those who did not. Those that had not received any technical support were not significantly different from those who received technical support.

Transparency of the CCFP

Predictor variables were similarly tested against farmers' perceptions of the transparency of the CCFP. This LR model exhibited a Nagelkerke R^2 of 65% with 91% of cases correctly classified. Farmers in Shaanxi had higher odds of considering the project process transparent in comparison to farmers in Sichuan (OR: 2.282; $p = 0.046$), while perceptions of transparency did not differ

Table 5 Regression output results with prospects as the dependent variable

Independent variables	B	S.E.	Wald	DF	Sig.	Exp (B)
Province			0.025	2	0.988	
Jiangxi	16.761	6420.762	0.000	1	0.998	1.90E+07
Shaanxi	− 0.147	0.936	0.025	1	0.875	0.864
Gender (1)	4.391	1.388	10.009	1	0.002	80.716
Age			2.450	2	0.294	
Age (24–34)	− 0.554	0.488	1.289	1	0.256	0.575
Age (35–54)	− 0.607	0.388	2.440	1	0.118	0.545
Education			7.550	2	0.023	
Education (no)	− 1.440	0.746	3.727	1	0.054	0.237
Education (school)	− 0.155	0.597	0.068	1	0.795	0.856
Difference	0.000	0.000	2.265	1	0.132	1.000
Technical support			46.902	2	0.000	
Technical support (no)	− 4.015	0.814	24.344	1	0.000	0.018
Technical support (some)	0.373	1.037	0.129	1	0.719	1.452
Gender * Province			9.631	2	0.008	
Gender (1) * Jiangxi	− 2.182	0.872	6.259	1	0.012	0.113
Gender (1) * Shaanxi	− 2.443	0.818	8.922	1	0.003	0.087
Province * technical support			12.057	4	0.017	
Jiangxi * technical support (1)	− 17.099	6420.762	0.000	1	0.998	0.000
Jiangxi * technical support (2)	− 16.941	6420.762	0.000	1	0.998	0.000
Shaanxi * technical support (1)	1.950	1.069	3.326	1	0.068	7.026
Shaanxi * technical support (2)	− 0.565	1.275	0.196	1	0.658	0.568
Gender * technical support			5.061	2	0.080	
Gender (1) * technical support (1)	− 2.593	1.255	4.269	1	0.039	0.075
Gender (1) * technical support (2)	− 1.561	1.342	1.352	1	0.245	0.210
Constant	3.580	1.023	12.258	1	0.000	35.886

B is the coefficient for the constant (also called the "intercept") in the null model

significantly amongst farmers from Jiangxi and Sichuan (Table 6). Male respondents had higher odds of perceiving the project as being transparent as opposed to female respondents (OR: 7.416; $p = 0.000$), but male respondents in Jiangxi and Sichuan had lower odds than male farmers in Sichuan (OR: 0.123; $p = 0.006$ and OR: 0.093; $p = 0.001$ respectively). Respondents between 35 and 54 years old had lower odds of considering the project sufficiently transparent compared to older farmers (OR: 0.398; $p = 0.005$). Farmers reporting no education had lower odds than university-educated respondents (OR: 0.166; $p = 0.009$), but no significant differences were found between respondents with high school and university-level education. There were also no significant differences in perceptions regarding program transparency between farmers who gained income from the program and farmers that did not. Those who did not receive any technical support were not significantly different than those who did.

Level of support for the CCFP

When level of support was used as the dependent variable, the LR model exhibited a Nagelkerke R^2 value of 68% and correctly classified 91% of cases. Farmers in Shaanxi had higher odds of supporting the program than respondents in Sichuan (OR: 6.552; $p = 0.000$), while farmers from Jiangxi were not significantly different from Sichuan farmers (Table 7). Male respondents had higher odds of support than female respondents (OR: 4.871; $p = 0.000$). Male respondents in Jiangxi and Shaanxi again had lower odds than those in Sichuan (OR: 0.156; $p = 0.005$ and OR: 0.132; $p = 0.001$ respectively). Questionnaire respondents between the ages of 34 and 54 had lower odds than younger and older age groups (OR: 0.439; $p = 0.015$), the former did not exhibit any significant variation from the oldest age group. Farmers with education levels lower than high school had lower odds of supporting the CCFP (OR: 0.167; $p = 0.015$), while respondents with high school and university level education did not significantly differ in their level of support. No significant differences were found

Table 6 Regression output results with transparency as the dependent variable

Independent variables	B	S.E.	Wald	DF	Sig.	Exp (B)
Province			8.911	2	0.012	
Jiangxi	− 0.786	0.544	2.090	1	0.148	0.456
Shaanxi	0.825	0.414	3.980	1	0.046	2.282
Gender (1)	2.004	0.562	12.720	1	0.000	7.416
Age			7.718	2	0.021	
Age (24–34)	− 0.735	0.418	3.086	1	0.079	0.480
Age (35–54)	− 0.92	0.331	7.717	1	0.005	0.398
Education			13.400	2	0.001	
Education (no)	− 1.797	0.683	6.925	1	0.009	0.166
Education (school)	− 0.21	0.536	0.153	1	0.695	0.811
Technical support			185.429	2	0.000	
Technical support (no)	− 4.385	0.450	94.772	1	0.000	0.012
Technical support (some)	− 0.982	0.491	4.002	1	0.045	0.375
Difference	0	0.000	2.742	1	0.098	1.000
Gender * Province			12.626	2	0.002	
Gender (1) Jiangxi	− 2.094	0.769	7.409	1	0.006	0.123
Gender(1) Shaanxi	− 2.372	0.686	11.973	1	0.001	0.093
Constant	4.52	0.817	30.600	1	0.000	91.864

B is the coefficient for the constant (also called the "intercept") in the null model

Table 7 Regression output results with support as the dependent variable

Independent variables	B	S.E.	Wald	DF	Sig.	Exp (B)
Province			17.903	2	0.000	
Jiangxi	0.281	0.531	0.280	1	0.597	1.324
Shaanxi	1.880	0.455	17.103	1	0.000	6.552
Gender (1)	1.583	0.434	13.329	1	0.000	4.871
Age			6.056	2	0.048	
Age (24–34)	− 0.529	0.430	1.511	1	0.219	0.589
Age (35–54)	− 0.823	0.340	5.867	1	0.015	0.439
Education			12.647	2	0.002	
Education (no)	− 1.789	0.737	5.893	1	0.015	0.167
Education (school)	− 0.051	0.563	0.008	1	0.928	0.950
Difference	0.000	0.000	5.017	1	0.025	1.000
Technical support			170.694	2	0.000	
Technical support (no)	− 5.173	0.616	70.573	1	0.000	0.006
Technical support (some)	− 1.104	0.665	2.752	1	0.097	0.332
Gender * Province			12.829	2	0.002	
Gender (1) * Jiangxi	− 1.858	0.665	7.813	1	0.005	0.156
Gender (1) * Shaanxi	− 2.028	0.620	10.689	1	0.001	0.132
Constant	4.398	0.917	23.019	1	0.000	81.274

B is the coefficient for the constant (also called the "intercept") in the null model

between farmers who experienced an increase in income from program implementation and those who did not. Those who had not received technical support were less likely to support the program than those who were supported.

Fairness of CCFP implementation

When the predictor variables were tested against farmers' perceptions of the fairness of the CCFP, the model had a Nagelkerke R^2 value of 72% and correctly classified 91%

Table 8 Regression output results with fairness as the dependent variable

Independent variables	B	S.E.	Wald	DF	Sig.	Exp (B)
Province			0.039	2	0.981	
Jiangxi	17.231	6934.748	0.000	1	0.998	3.04E+07
Shaanxi	0.250	1.274	0.039	1	0.844	1.285
Gender (1)	1.436	0.543	6.990	1	0.008	4.202
Age			3.880	2	0.144	
Age (24–34)	− 0.485	0.448	1.171	1	0.279	0.616
Age (35–54)	− 0.673	0.343	3.859	1	0.049	0.510
Education			11.720	2	0.003	
Education (no)	− 1.612	0.775	4.322	1	0.038	0.200
Education (school)	0.002	0.631	0.000	1	0.998	1.002
Difference	0.000	0	9.187	1	0.002	1.000
Technical support			65.490	2	0.000	
Technical support (no)	− 6.142	1.07	32.959	1	0.000	0.002
Technical support (some)	0.442	1.43	0.096	1	0.757	1.556
Gender * Province			7.292	2	0.026	
Gender (1) * Jiangxi	− 1.948	0.787	6.119	1	0.013	0.143
Gender (1) * Shaanxi	− 1.507	0.659	5.236	1	0.022	0.222
Province * technical support			20.662	4	0.000	
Jiangxi * technical support (1)	− 16.849	6934.748	0.000	1	0.998	0.000
Jiangxi * technical support (2)	− 18.577	6934.748	0.000	1	0.998	0.000
Shaanxi * technical support (1)	1.876	1.301	2.077	1	0.150	6.524
Shaanxi * technical support (2)	− 2.369	1.628	2.117	1	0.146	0.094
Constant	4.596	1.25	13.526	1	0.000	99.060

B is the coefficient for the constant (also called the "intercept") in the null model

of cases. No significant differences were found between farmers in different provinces in terms of their perception of program fairness, but male respondents had higher odds of finding the program fair compared to female farmers (OR: 4.202; $p = 0.008$), and male respondents in Sichuan were significantly more likely to consider the program fair than those in Jiangxi and Shaanxi (OR: 0.143; $p = 0.013$ and OR: 0.222; $p = 0.022$ respectively) (Table 8). Respondents between the ages of 35 and 54 had lower odds of considering implementation fair than other age groups (OR: 0.510; $p = 0.049$). Respondents in the lowest educated group had lower odds of viewing the program implementation as fair (OR: 0.200; $p = 0.038$), while no significant differences were found between those with high school education and those with university level education. No significant differences were found between respondents' perception of fairness for farmers who experienced an increase in income as a result of the program compared to those who did not. A lack of technical support decreased respondents' odds of considering the program fair.

Discussion and conclusion

This study investigated the influence of socio-economic factors on the perception of local farmers of three provinces towards the CCFP. Findings reveal that education, income difference, age, gender, and technical support are important influential factors affecting perceptions towards the CCFP.

A summary of the main results is provided in Table 9 where the significance of each OR is denoted "Sig" or "Not Sig" for significant and not significant. Additionally, (+) and (−) indicates whether the odds were higher or lower relative to the base group.

Farmers from the three provinces had mixed perceptions towards the CCFP. Sichuan and Jiangxi farmers were not significantly different in their perception of the CCFP in terms of willingness to participate, prospects, transparency, support, and fairness, while farmers from Shaanxi did differ significantly in their views of the program. While we are unaware of other literature that explores these differences in responses, experiences and perceptions of farmers across different provinces in China, these differences may be explained by environmental and socio-economic

Table 9 Summary of significance of regressions

Item	Confidence (1)	Willingness (2)	Prospects (3)	Transparency (4)	Support (5)	Fairness (6)
*Sichuan**						
Jiangxi	Sig (−)	Not Sig (+)	Not Sig (+)	Not Sig (−)	Not Sig (+)	Not Sig (+)
Shaanxi	Not Sig (−)	Sig (+)	Not Sig (−)	Sig (+)	Sig (+)	Not Sig (+)
*Female**						
Male	Sig (+)	Sig (+)	Sig (+)	Sig (+)	Sig (+)	Sig (+)
*Age (55+)**						
Age (24–34)	Sig (−)	Not Sig (−)	Not Sig (−)	Not Sig (−)	Not Sig (−)	Not Sig (−)
Age (35–54)	Sig (−)	Sig (−)	Not Sig (−)	Sig (−)	Sig (−)	Sig (−)
*Education (University)**						
Education (none)	Sig (−)	Sig (−)	Not Sig (−)	Sig (−)	Sig (−)	Sig (−)
Education (school)	Not Sig (−)	Not Sig (−)	Not Sig (−)	Not Sig (−)	Not Sig (−)	Not Sig (+)
Income difference	Sig	Not Sig	Not Sig	Not Sig	Sig	Sig
*Technical support (high)**						
Technical support (no)	Sig (−)	Sig (−)	Sig (−)	Sig (−)	Sig (−)	Sig (−)
Technical support (some)	Not Sig (−)	Not Sig (−)	Not Sig (+)	Sig (−)	Not Sig (−)	Not Sig (+)

Sig is significant ($p < 0.05$); Not Sig is not significant ($p > 0.05$); (+) (−) indicates higher or lower odds relative to base group; * indicates base group

diversity between the provinces. For example, Sichuan and Jiangxi are in the Yangtze River drainage basin, while Shaanxi is in the Yellow River drainage basin. For this reason, farmers from Sichuan and Jiangxi may have shared experiences in terms of natural disasters. Previous research has reported an increased likelihood in facing serious flooding in the middle and lower Yangtze basins, where these two provinces are situated, due to an upward trend in total precipitation (Zhang et al. 2005) and an increased frequency of precipitation extremes (Su et al. 2005). Moreover, since these two provinces lie in the same drainage basin, which may have facilitated more interaction between the farmers and may have resulted in similar responses towards the CCFP. Given these findings, we recommend further detailed investigation on the outcomes, experiences and perceptions of farmers' living in different provinces towards the CCFP.

Significant gender-dependent differences in perceptions of the CCFP were found. In all LR models, male respondents were more likely to positively perceive and support the program compared to female respondents. These findings are consistent with previous research on farmers' perceptions of the CCFP, which have reported that women are less likely to have positive views of the CCFP as they are more vulnerable than males due to their lower incomes and education (Cao et al. 2009; Feng and Xu 2015). Moreover, male farmers in Sichuan held the most positive perception of the program, which may be due to a relatively higher rural GDP in Sichuan in comparison to Jiangxi and Shaanxi (NBS 2016). A higher income in Sichuan could lower concern regarding financial stability and, since farmers in this province are able to meet their basic survival needs, could increase concern for environmental sustainability.

In cross-analyzing socio-economic factors with dependent variables related to perception, the oldest (55+ years) and the youngest (24–34 years) age groups exhibited positive responses towards the CCFP. Middle-aged (35–54 years) farmers did not support the program across most of the dependent variables tested, (with the exception of prospects of the CCFP). One possible explanation for the negative perception of the program by middle-aged farmers is that this age group is less receptive to new technologies and skills than younger farmers, and as such would be less able to adapt to new livelihoods than younger skilled workers. This is supported by the findings of Heckman (2005) which reported similar results. In addition, this group of farmers often work as off-farm labour in urban areas outside of their native village. As a result, this may cause a disconnect between them and the social, environmental and economic contributions of the CCFP since these farmers are less dependent on their income from the program and therefore less concerned about it. Additionally, 55+ year-old farmers, having lived in the area for a longer time, may have more environmental concerns because of their past experience with environmental disasters such as soil erosion and flooding. As such, those belonging to the oldest age group may have greater awareness of the negative effects of natural disasters on their social and economic well-being through land

degradation, and therefore have greater support for restoration policies such as the CCFP. This is consistent with the results of the survey analysis of Sjögersten et al. (2013) of farmer perceptions which reported older farmers' support for similar land-use policies.

Respondents with basic high school and higher university education tend to be more supportive and confident in the CCFP when asked about aspects such as transparency, fairness, and prospects. In contrast, those without a basic level of education perceived the project as less fair, less transparent and were less willing to participate. This may be because those farmers with some form of formal education have stronger environmental awareness and therefore a greater understanding of the benefits and costs associated with environmental issues. Therefore, these farmers tend to show more positive support towards the CCFP. In addition, farmers with higher education have more job opportunities in non-agricultural sectors due to their skilled migratory work compared to those with no education (Uchida et al. 2009), and as a result are more likely to support and benefit from the CCFP. These findings are consistent with previous research in China where more educated farmers have shown more support for environmental policies compared to less educated farmers (Cao et al. 2009; Qu et al. 2016).

Findings suggest that a change in income since implementation of the program does influence farmers responses to the program in terms of confidence, support and fairness. Respondents reported an increase in income of 14,751.46 RMB after CCFP implementation (Table 1), suggesting that economic benefits contributed to the positive responses. These benefits are directly yielded from the CCFP payments and from allowing affected populations to participate in off-farm labour (Xu et al. 2006). This can also be inferred from our data as shown in Table 1, since on average households have one migratory worker who works around 176 days of migratory work, which is almost half of the calendar year. Interestingly, income differences did not influence farmers' willingness to participate in the program, or their perception of prospects and transparency of the program, implying that social factors also play a large role in understanding, perception, and attitude towards the CCFP along with economic factors. From a policy standpoint, this suggests that, aside from providing appropriate financial compensation, social factors also need to be considered for successful and effective land-use policies. Increased communication and engagement by the government could be used to avoid isolating less advantaged (i.e., lower skilled, less educated) members of the population, as this disconnection between policy makers and the target population is often an issue encountered in top-down policy implementation when policy makers are far removed from the local population (DeLeon and DeLeon 2002).

Another key finding of this analysis is that receiving technical support from the government improved the perception of the farmers towards the CCFP. This is because technical support such as planting and tending of seedlings, particularly during the establishment phase, has been shown to increase the survival rate (Bennett et al. 2014), and in turn, helps secure subsequent benefits for the farmers and support for the program. This suggests that technical support is key for ensuring survivorship of the seedlings and achieving the desired ecological and economical outcomes of the CCFP (Bennett et al. 2014).

This study provides detailed insight into the socio-economic determinants of farmers' perceptions towards the CCFP and provides a set of profiles of the ideal target population for future government efforts in developing and implementing sustainable and effective land-use policies. Findings suggest that failure to elicit farmers' socio-economic determinants and perceptions may result in poor and ineffective policies. This study revealed that rural, male, educated, non-middle-aged farmers who have received technical support are more likely to have a positive perception of the CCFP and support the program. This knowledge could help to improve land management and public perception of national land-use programs. When implementing policy that involves participation of a target population, the state could identify individuals from the aforementioned groups that generally hold positive perceptions of such policies and are more likely to manage the land in an environmentally beneficial way to continue China's land conservation efforts. On the other hand, in addition to greater communication and engagement with the affected population, priority could be given to disadvantaged members of the population, whether by skills, education, or age, as indicated in this study, to improve environmental awareness and appreciation. Most importantly, the government could use these findings to create an enabling environment for these disadvantaged groups of farmers by providing training programs and capacity-building so that all farmers are better prepared for the transition and better able to adapt to migratory work in skilled jobs in more urban areas while their farmland is converted to forestland. Our results provide insight into the influence of socio-economic characteristics on the perceptions of farmers towards land-use policies, which has important implications for designing targeted policy instruments. These insights can be harnessed and further evaluated in future research in order to improve citizen engagement, support, and understanding and help ecological restoration and conservation objectives to be more effectively achieved.

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